

# AUTOMATED SYSTEM FOR ASSISTING THE ARCHITECTURAL PROCESS

## BACKGROUND OF THE INVENTION

5 The typical process by which architects and engineers are hired and do their work includes many steps. For example, an owner develops a concept that describes a proposed building's use and approximate size. He then engages the architect. The architect hires the required engineers, and the team produces a design and a contract document in keeping with the concept and budget. This contract document is composed of computer-generated Drawings and written Schedules and Specifications. Taken together these documents  
10 represent all physical and cost aspects of the complete building. Currently, the graphics software used in this process is industry specific; the text software is general business.

The aspects of the contract document, including the Detail, Specification and Schedule, are then bid by general contractors and after some revisions, are assumable into a contract between the owner and the contractor. The architect observes the construction for  
15 compliance with the design.

The architect's prime interest lies in the conceptualization and design development phases. The creation of the aspects of the contract document, however, including the Detail, Specification, and Schedule development (aspects of the contract document), as well as their coordination, require high technical expertise and precision, and are considered  
20 drudgery by many. These tasks often suffer from lack of time, interest or sufficient experience. In fact, they are often performed by junior members of the firm who lack the experience to do them efficiently and thus require extensive oversight by senior members of

the firm. Shortcomings in the final document may result in project cost overruns for the owner and hours of unanticipated work for the architect.

In view of this, several chronic problems exist in the architectural, engineering and construction industry. One is the backbreaking amount of detail work required of the professionals, within ever shrinking schedules, resulting in higher stress, higher costs and lower incomes. Another is the difficulty and time-consuming process of obtaining manufacturer's information as it is needed. Compounding these problems is the existence of only a few options for automating any portion of the architectural design development process. This industry is one of the least automated of all industries.

Architects and engineers are hired to design buildings and other structures. In order to get these structures built, the architects and engineers produce what is called a contract document, which comprises several complimentary aspects, including the agreement between the Owner and Contractor; the drawings, which include plans, elevations, sections, and Details; Schedules, which list attributes of repetitive building parts such as doors, windows, hardware, and finishes; and the Specifications, which are the written, detailed descriptions of the materials and processes that make up the building. A Schedule, for example, would indicate to a contractor what type of finish a door might have, and a Specification would indicate how that finish is applied.

At present, these aspects are created primarily manually and independently of one another. That is, each one requires its own input and execution, and the coordination between each is done manually by the architect and engineer. Each of these aspects has it

own characteristics. Some are project specific and others are simply modifications or variations on a standard Detail.

The system of the present invention automates the architectural process. Plans, elevations, and sections are project specific, but a majority of Details, which are the graphic description of the assembly of construction elements, are standard, with some variation from project to project. For example, a floor plan is unique to a particular project, and is therefore needed to be drawn for that project. However, a door or window Detail, which is the drawing that shows how the unit fits into a particular wall, can be generalized and therefore used on any project that has those same conditions.

In preparing aspects of the contract document, including Drawings and Specifications, architects and engineers rely on production tools, such as computer programs, and information, such as manufacturers' literature. Architects and Engineers perform tasks at the levels of output; that is, they produce aspects of a contract document in their final form; there is no intermediate input form process that they use. A Schedule, which is a device used by architects and engineers to provide detailed information about a door, window, room finish or the like, are created for each item in a CAD format or in spreadsheet form where each cell is populated manually. A Detail, which is a drawing that shows the actual assembly of parts, is drawn one line at a time or old files are retrieved and modified. A Specification is prepared by modifying a previous Specification or using a database or word processing-based template. The production tools that attempt to assist with more than one aspect of the contract document do not do so automatically in that the process of generating a second aspect, if it is available at all, requires additional steps

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beyond a single entry of information into the system. Such additional steps may include downloading a Detail library and separately selecting generic Details that may additionally require modification to reflect the various attributes desired. Thus, the drawing, specifying, and product selection are three distinct processes that are currently disconnected and not automated. More recently, for Specifications, a program using an actual user interface that is not in a word processing format has been available; it uses a directory tree structure. Also available is a program that uses a database format user interface where text is viewed in a data base cell. The present invention advances the automation of the architectural process by use of a system that provides for a single entry of information for assembling the data required and for generating the aspects of the contract document used by Architects and Engineers.

#### SUMMARY OF THE INVENTION

The present invention relates to an open-network system for managing the architectural process. A user, usually at a location remote to the database of the system, uses a graphical user interface to input data that is assembled to generate the aspects of the contract document required for the project, including the Specifications, Details, and the Schedules. The user selects attributes in designing the architectural project, and as appropriate, is provided with choices from one or more sources, such as a manufacturer's catalog, that satisfy the criteria of the attributes selected. In addition to providing specific information to the various aspects of the contract document, this selection and filtering aspect of the invention provides a time-, and therefore, cost-savings for the project by

quickly providing information to the user that traditionally an architect or engineer may spend many hours trying to uncover. Additionally, by filtering the choices applicable for a selected set of attributes of a design part, and providing the user with information about that part in a form that is used in generating the aspects of the contract document automatically, errors may be significantly diminished or eliminated. The process may be further facilitated by providing the user with an image, which may be a portion of an image map. In this way, the user may choose parts by clicking on the image. The data associated with that part may then populate the input form and aspects of the contract document, as appropriate for that part.

The invention comprises data entry means for user-selected project attributes, at least one catalog database from which the user-selected attribute is identified, each attribute having a unique identifier and data associated with it, a filter for providing a graphical user interface with filtered data associated with a user-selected attribute, at least one user database which stores the unique identifier of the user-selected attribute, automated selection means for incorporating data associated with the user-selected attribute into at least one aspect, and generation means for creating the aspect. The aspects may be the Specification, Detail, Schedule, status of the architectural process, or the like. The data entry means may be a graphical user interface having text entry and drop-down menu choices. The system may include at least one remote catalog database from which the user-selected attribute is identified, each attribute having a unique identifier and data associated with it. The filter provides the drop-down menu choices of the graphical user interface with filtered data associated with a user-selected attribute. The system of the present invention may further

include means for tracking the architectural process. The invention may also include searching means for querying a user database or a group of user databases. The aspect created by the generation means may include Industry Foundation Class tags for industry compatibility. This may be in XML, or other suitable form, such as object-oriented files.

5           The present invention uses an input form to gather design information about an architectural project or part of a project for assembly and placement in the aspects of the contract document, including a Schedule, Specification, Detail, or the like, as appropriate. The system allows multiple tasks to be performed with a single entry or selection of information. One embodiment of the invention further includes a module for tracking the  
10       status of the design process.

          Accordingly, it is an object of the present invention to provide a system to enable architects and engineers to integrate their most basic and time-consuming tasks into one task.

          Another object of the present invention is to provide a system to enable architects  
15       and engineers to generate multiple aspects of the contract document with a single entry of information.

          A further object of the present invention is to provide a system to automate the creation of multiple aspects of the contract document.

          Still another object of the present invention to provide a system with resources for  
20       preventing errors in creating a contract document.

          Yet another object of the present invention to provide a system that allows for faster completion of a contract document.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description to follow. It should be understood, however, that the detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of an embodiment of the present invention;

Fig. 2 is a screenshot of a browser-based input form.

Fig. 3 is a data flow diagram depicting the manner in which user-selected attributes are filtered.

Fig. 4 is a block diagram of an embodiment of the present invention.

Fig. 5 is a data flow diagram depicting the manner in which the data input flows to the create the Project Data.

#### DETAILED DESCRIPTION

The architectural process by which architects and engineers are hired and do their work begins with an owner developing a concept that describes a proposed building's use and approximate size. He then engages the architect. The architect hires the required engineers, and the team produces a design and a contract document, in keeping with the concept and budget. This contract document includes a number of documents making up the various aspects of the contract document, such as computer-generated Drawings and written Schedules and Specifications. Taken together, these documents represent all physical and cost aspects of the complete building. The aspects of the contract document are then bid by

general contractors and after some revisions, are assumable into a contract between the owner and the contractor. The architect observes the construction for compliance with the design.

The architect's prime interest lies in the conceptualization and design development phases. The creation of the aspects of the contract document, however, including the Detail, Specification, and Schedule development, as well as their coordination, require high technical expertise and precision, and are considered drudgery by many. These tasks often suffer from lack of time, interest or sufficient experience. In fact, they are often performed by junior members of the firm who lack the experience to do them efficiently and thus require extensive oversight by senior members of the firm. Shortcomings in the final documents may result in project cost overruns for the owner and hours of unanticipated work for the architect.

The system of the present invention uses an open-network to facilitate the exchange of information and for providing single entry input forms to the user. The system integrates four databases that may function simultaneously to provide the desired output.

Fig. 1 is a block diagram of a preferred embodiment of the present invention. To the User Interface 101, the Attribute Information Storage Means 120, including one or more of the Schedule database 121, the Catalog database 122, Drawing database 123 and the Specification database 124, provides through drop-down menus, for example, selections that are associated with data, such as attributes and the like, in the respective databases. This process is facilitated through the use of worksheet-specific data collection and binding. Through the User Interface 110 that permits a one-time input of data for creation of multiple



outputs, the user makes selections which, along with the selections associated data, populate a User Database 130. The User Database 130 is then used to generate one or more aspects of the contract document 140, such as Specification 141, Schedule 142, and Drawing 123. For example, when the manufacturer and project-specific data about one window is entered, the system automatically enters that data, as appropriate, in the window Schedule 122, selects and draws the appropriate Drawing 143 for that window, and selects and writes the appropriate Specification 121 sections for that window. Additionally, the User Database 130 may store template and project administration data.

In another embodiment of the invention, the system may include a utility, such as for creating the parts of a Drawing 143 from existing Drawing 143 parts, such as those in CAD format. A collection utility may collect the drawn representations of the parts, and also the parameterized dimensions and descriptive names for the parts, and assembles the information into a database. A diagram utility may create a parts diagram for a Drawing 143. The diagram is created from a series of vector equations that comprise the geometry of the parameterized parts of the Drawing 143. The diagram utility may have two interfaces. A human interface allows for the Drawing part to be drawn or previewed before being drawn. A program interface allows other programs to create a Drawing 143 from the information in the database.

Fig. 2 is a screenshot of a browser-based Input Form 200 for Doors. An Input Form 200 is organized by Divisions, Schedules and Specification sections, including the data needed to generate those documents. The input form is specific for each category of work such as doors, windows, ceramic tile, flooring, and the like so it may readily be visible on a

computer screen in as many screens as is necessary. In this way, the product selections, Schedules, Specifications, and Details are all developed for each category from one form. Once input, data may follow different data paths as illustrated below.

Some of the data is selected from drop down boxes by the User. These selections are stored in a User Data Base for retrieval when the contract documents 140 are generated for preview or saved for download. This data can be used for only a single output document, such as the Schedule, for the Schedule 141 and the Specification 142, for the Schedule 141 and Detail, or for all three.

Some of the data is keyed in by the user into input boxes. As with the drop-down selections, these selections are stored in a User Data Base 130 for retrieval when the aspects 141, 142 and 143 are generated for preview or saved for download.

Some of the data that is selected from drop down boxes by the User may open in a browser a manufacturer catalogue page from which the user selects a catalogue item. The attributes of that item populate the Input Form 200 and are stored in a User Data Base 130 for retrieval when a Schedule 141, Specification 142, or Drawing 143 is generated for preview or saved for download. This data may be assembled for generation of one or more of the various aspects of the contract document 140.

An item selected from the catalogue page that is a drawing, such as that available in \*.dwg format, would become a part for inclusion in the Drawing 143 for that item. For example, a manufacturer's stock Detail for a window would be inserted into a window Detail for a specific project based on the other User selections, as described below for drawing data.

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The user selects a template for a drawing from a drop-down box on the User Input Form. The user then selects parts from a list in one or several drop-down boxes. These selections are stored in a User Data Base 130 . When the Drawing 143 is generated for preview or download, the information is assembled from the User Database 130 and the

5 Drawing 143 is drawn using the template and the parts selected. Parts selected from a manufacturer's catalogue would also be selected and assembled into the Drawing 143.

Data is selected from drop-down boxes by the User. These selections are stored in a User Data Base 130 and are retrieved when the Specification 142 is previewed or generated for download. This data can be used for a Specification 142, for a Specification 142 and a

10 Schedule 141, for a Specification 142 and a Drawing 143, or for all the three.

Fig. 3 is a data flow diagram depicting the manner in which user-selected attributes are filtered. In one embodiment, the graphical User Interface 110 or GUI is the scheduler form. Through the User Interface 110, the user selects the design information representing all possible input choices, such as user input text, user selected choices from the drop down

15 menus related to one or more of the Attribute Information Storage Means 120. This text is associated with unique identifiers that are stored in the Memory 310 and the unique identifiers are compared with the information in the Attribute Information Storage Means 120. This comparison provides the basis for filtering choices by the Filter 320 that will appear on the user's Display as the user continues on a Worksheet.

20 Fig. 4 is a block diagram of an embodiment of the present invention. Any Project Data 410 input into the system, whether related to design or other project aspects, such as using a project status input form, and from user text, user selections or imported from other

digital forms, is stored in the Memory 310 and assembled with or without data from the Attribute Information Storage Means 120, to generate one or more outputs, including, a Specification 142, Drawing 143, Schedule 141, Project Status Report 420 or an Industry-standard Format Report 430, such as XML, or Industry Foundation Class tags, needed for contractors and maintenance persons to search.

Fig. 5 shows more of a breakdown of the data input that makes up Project Data 410 as shown in Fig. 3 in that each Division 510 comprises data combined from several Worksheets 520, and in turn, the combination of Divisions makes up Project Data 410. This may include any imported, rather than input data.

The data selected and stored in the User Database 130 is automatically associated with the appropriate aspects of the contract document 140 and assembled into the aspects when requested. Each Worksheet 520 may have all or most types of associations. For example, text may be associated for use only in a Schedule 141, in a Schedule 141 and a Specification 142, or only in a Specification 142. Text may be used to select CAD parts or a CAD template. Additionally, text that is associated for use in the Schedule 141 or Specification 142 may also be used to select CAD parts or CAD templates. In another embodiment, text that is associated for use in the Schedule 141 or Specification 142 may also be used to select product attributes for catalogue and manufacturer selection.

The text may be populated by records from a previously completed Schedule 141, such as a hardware type label on a Worksheet 520, such as a Door Schedule Worksheet, such that the box on the Worksheet 520 would remain blank until a hardware Schedule is started. In another embodiment, the text may be populated from a search of product

attributes. For example, in this embodiment, upon selecting a manufacturer for a certain piece of hardware, the user is provided a scanned and image-mapped catalogue page from which to select an item. The associated CAD part is queued for insertion in the Drawing 143. Upon selection of an item, the data associated with that item may be used to populate the text boxes automatically. If no data is associated with that item, the user may add the appropriate data.

Text for use on a worksheet 520 may be populated from other worksheets 520 to select details already created in those other worksheets. For example, in some cases, details already created in other worksheets may be used to create the details of a second worksheet 520.

The user may save any or all Worksheets 520 as a standard template for that particular Worksheet for a given type of project. It may be within a particular project type and building code, so that the Worksheets 520 that have been selected as templates will be populated with data when a new project is started within one or both of the project and building code types.

Users may select type of form to view for each Worksheet 520, such as a Worksheet for one or more of the Schedule 141, Drawing 143 or Specification 142. In one embodiment, access for functions such as editing may be restricted to certain users. In another embodiment, the user may have access to customize a header. Users may have access to data such as a list of consultants, and information related to those consultants, for each Worksheet 520. Internal links, such as to status sheets, a new project page, or the like may be provided.

In the present invention, the data required for developing the Schedules, though unique for each project, is used to link a Specification, Schedule and Detail together. This is particularly advantageous, for in most cases, this is the one step in the process that architects take, regardless of whatever else they draw or what Specifications they write.

5 In that same vein, it should be noted that a building is designed from the outside in, or from the general to the specific. The plans and elevations, which are pictures of the sides of a building, are usually the first to get designed with the sections and Details to follow. If an architect runs out of time in developing the aspects of the contract document, the Details and Specifications may suffer for lack of adequate attention, for in general, these items are  
10 lowest on an architect's priority. Therefore it will benefit the architect greatly to have these tasks automated as much as possible.

All of the above data paths may work simultaneously. The work can be previewed at any time in any format. Any one or all documents may be generated. All documents may be automatically stored for future download. All documents may be saved in a format  
15 selected by the user, for example, the documents may be saved in .dwg, .dxf, .rtf, .doc, .wpf, .xls, or other formats.

As the user moves from Worksheet to Worksheet, record to record, or detail to detail, the previous work may be recorded in the User Data Base 130 for later retrieval. The User Data Base 130 functions as a switching device that stores all the selected items and their  
20 associated unique identifiers. It may also include industry-acceptable tags such as Industry Foundation Class tags. When the user requests that the various documents be generated, this User Data Base 130 is queried and the documents generated.

Schedules may be created, for example, in spreadsheet, CAD, XML or other formats that will be apparent to one skilled in the art. The user may preview a Schedule, and may print it. The user may select a record in the previewed Schedule and toggle to that record on a Worksheet. Changes may be made to the Schedule, which may also allow for related  
5 changes to the Worksheet. The Schedule file may be created upon a command from the user or created automatically.

Drawings may be created, for example, in CAD or other formats that will be apparent to one skilled in the art. The user may select a template and all required parts for a Detail, which may be previewed and printed. The user may also digitally store the Drawing.  
10 In one embodiment, Drawing creation may be accomplished by commands from the User Database 130 or a middle tier program, which would instruct a CAD program to open a template file and enter the selected parts to create the Drawing, which can then be previewed or stored as desired.

Specifications may be created, for example, in XML, word processing or other  
15 formats that will be apparent to one skilled in the art. The Specification may be editable and “autoformatted”, such that the information is linked to provide for automatic re-numbering of paragraphs and subparagraphs, as changes are made. The Specifications may be previewed as the data begins to populate it. There may be provided a text editor to assist in editing a final draft of the Specification. The associated digital file may be saved and  
20 retrieved, for example, by any available means, such as by FTP (file transfer protocol).